E-1 PIPE/CULVERT INSTALLATION

PURPOSE & APPLICATIONS

A water conveyance conduit is a pipe installed beneath the surface of the ground with or without inlet devices to collect surface and subsurface water and to convey it to a suitable outlet without causing damage by erosion or flooding. This practice applies where:

- Excess surface and subsurface water needs to be disposed of,
- A buried outlet is needed for diversions,
- An underground outlet can be installed to safely dispose of excess water,
- Surface outlets are impractical because of stability problems, climatic conditions, land use, or equipment traffic.

CONSIDERATIONS

A pipe installed in or discharging to a stream will require a state permit under the Natural Resource Protection Act.

Every effort should be made to use surface ditching or channels rather than underground enclosed pipe systems for the following reasons:

- Underground enclosed pipe systems are prone to plugging with trash and debris, requiring constant maintenance. Surface ditching is less prone to plugging and problems are immediately obvious.
- If underground systems fail, they are very difficult and costly to repair.
- Surface ditching provides opportunities for pollutants to be volatized and exposed to ultraviolet light which promotes their decomposition. Vegetated ditches can also promote biological metabolism and decay of these pollutants.
- A subsurface system will reduce groundwater recharge since infiltration is reduced.

SPECIFICATIONS

Design Specifications

Capacity: The underground outlet shall be designed with adequate capacity to ensure that the system functions according to the standards for the specific practice. For example, an underground outlet can be used in combination with a diversion, waterway, or a surface drain to carry part or all of the design flow. The capacity of the underground outlet for natural basins must be adequate for the intended purpose without causing damage to local works of improvements. The size (frequency in years) of the design storm will be based on state or local regulations as appropriate.

Inlet: An inlet can be a catch basin, collection box, a perforated riser, or other appropriate devices. Its capacity shall be adequate to provide the maximum design flow in the conduit or a flow-control device should be installed. Refer to the PIPE INLET PROTECTION BMP for additional information.

Perforated risers must be of durable material, structurally sound, and resistant to damage by rodents or other animals. Catch basins must be large enough to facilitate maintenance and cleaning operations. The inlet must have an appropriate trash guard to ensure that trash or other debris entering the inlet passes through the conduit without plugging. The trash guard must also be capable of preventing the entry of people and animals. Pressure-relief facilities shall be designed and installed if needed to control uplift pressures. If junction boxes and other structures are needed, they shall be designed and installed in a manner that facilitates maintenance activities.

Outlets: The outlet shall be sufficiently stable for all anticipated flow conditions. It shall be designed for the maximum anticipated water surface at design flow. A continuous section of closed conduit with a headwall shall be used at the outlet. The outlet will include an armored plunge pool or apron, or other energy dissipation device. Refer to the PIPE OUTLET

PROTECTION BMP. The design of the energy dissipater will dictate the type of outlet pipe support (reinforced concrete bedding and pier) needed to maintain stability. All outlets must have a positive animal guard to prevent entry of people and animals.
Protection: Before the outlet is installed, all disturbed areas shall be reshaped and regraded so that they blend with the surrounding land features and conditions. Areas that are not planned to stay bare or covered by structural works shall be established to vegetation or otherwise protected from erosion as soon as possible after construction.

Construction Specifications

Conduits and appurtenances shall be installed to the line and grade shown in the plans or as staked in the field and according to the recommendations of the manufacturers. Conduits shall be bedded and backfilled with the native material if suitable or with a well-compacted sand. The ends of the conduits shall be protected during installation. All appurtenant structures, including trash and animal guards, shall be installed promptly, and provisions shall be made for protecting them during installation.
Vegetation, riprap or other protective cover must be established promptly within 7 days of installation.

Material Specifications

Materials shall meet or exceed the design requirements against leakage and must withstand internal pressure or vacuum and external loading. Plastic, concrete, aluminum, and steel shall meet the requirements specified in the material specification section following, or specified MDOT specs appropriate for the design for internal pressures and external loading. All materials specified for subsurface drains can be used for underground outlets if designed for proper pressure conditions. Conduits can be perforated or non-perforated, depending on the design requirements.

MAINTENANCE

Underground culverts must be maintained by keeping inlets, trash guards, and collection boxes and structures clean and free of materials that can reduce the flow. All leaks shall be repaired promptly to ensure proper functioning of the conduit. Animal guards must be inspected periodically and maintained in proper working order.

CULVERT SIZES (ROUND) FOR STREAM CROSSINGS (3x RULE)

AVERAGE STREAM WIDTH

Take two measurements across the stream from bank to bank where you intend to place the culvert. Measurements should be taken at the normal high water line (NHWL). To find the NHWL during low flow periods look for water stains on rocks or a debris line along the bank. Add the first measurement to the second and divide this number by 2. This equals the average stream width.
Example: 36in. + 47 in. = 83in. 83 ¸ 2 = avg. stream width of 41.5 inches. (Round up to 42in.)

AVERAGE STREAM DEPTH

Take 3 measurements from the bottom of the stream to the NHWL.
Add the measurements together and divide this number by 3. This equals the avg. stream depth.
Example: 12in. + 16in. + 14in. = 42in. 42 ¸ 3 = average stream depth of 14 inches.

USING THE TABLE

Take the average width and depth figures and determine where they intersect on the table above.
*For example, for an average stream width of 42 inches (on the left side of the table), and an average stream depth of 14 inches (along the top of the table), the intersect shows a culvert diameter of 48 inches.

Average Stream Width		Average Stream Depth (Inches)															
Feet	Inches	2	4	6	8	10	12	**14***	16	18	20	22	24	26	28	30
1	12	12	15	18	21	21	24	30	30	30	30	36	36	36	36	42
1.5	18	12	18	21	24	30	30	36	36	36	42	42	42	42	48	48
2	24	15	21	24	30	30	36	36	42	42	48	48	48	54	54	54
2.5	30	15	21	30	30	36	42	42	48	48	48	54	54	60	60	60
3	36	18	24	30	36	42	42	48	48	54	54	60	60	60	66	66
3.5	**42***	18	30	36	36	42	48	**48**	54	54	60	60	66	66	72	72
4	48	21	30	36	42	48	48	54	54	60	66	66	66	72	72	78
4.5	54	21	30	36	42	48	54	54	60	66	66	72	72	78	78	84
5	60	21	30	42	48	48	54	60	66	66	72	72	78	78	84	84
5.5	66	24	36	42	48	54	60	60	66	72	72	78	78	84	84	90
6	72	24	36	42	48	54	60	66	66	72	78	78	84	90	90	96
6.0	78	24	36	42	54	60	60	66	72	78	78	84	90	90	96	96
7	84	30	36	48	54	60	66	72	72	78	84	84	90	96	96	102
7.5	90	30	42	48	54	60	66	72	78	84	84	90	96	96	102	102
8	96	30	42	48	54	66	66	72	78	84	90	90	96	102	102	108
8.5	102	30	42	48	60	66	72	78	84	84	90	96	102	102	108	108
9	108	30	42	54	60	66	72	78	84	90	96	96	102	108	108	114
9.5	114	30	42	54	60	66	72	78	84	90	96	102	102	108	114	114
10	120	30	48	54	66	72	78	84	90	96	96	102	108	114	114	120
10.5	126	36	48	54	66	72	78	84	90	96	102	108	108	114	120	120
11	132	36	48	60	66	72	78	84	90	96	102	108	114	114	120	126
11.5	138	36	48	60	66	78	84	90	96	102	108	108	114	120	126	126
12	144	36	48	60	66	78	84	90	96	102	108	114	120	120	126	132
12.5	150	36	48	60	72	78	84	90	96	102	108	114	120	126	132	132
13	156	36	54	60	72	78	90	96	102	108	114	114	120	126	132	138
13.5	162	36	54	66	72	84	90	96	102	108	114	120	126	132	132	138
14	168	36	54	66	72	84	90	96	102	108	114	120	126	132	138	144
14.5	174	36	54	66	78	84	90	96	108	114	120	126	126	132	138	144
15	180	42	54	66	78	84	96	102	108	114	120	126	132	138	144	144